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## VALUE OF RESPIRATORY GYMNASTICS

*In Maintaining the Integrity of the Lungs,  
and as an Aid in the Treatment of  
Diseases of these Organs.*

BY

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# THE VALUE OF RESPIRATORY GYMNASTICS IN MAINTAINING THE INTEGRITY OF THE LUNGS, AND AS AN AID IN THE TREAT- MENT OF DISEASES OF THESE ORGANS.<sup>1</sup>

BY EDWARD O. OTIS, M.D., BOSTON,

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IN the differentiation of medical work and the minute attention which is accorded to each organ of the body, the function of respiration seems, in a measure at least, to have escaped the careful attention granted the other vital processes. One consults his physician and is interrogated by him to see, for example, if his kidneys are acting properly or his heart is in order; if his digestion is well performed and his diet correct; or his hepatic secretion normal; but frequently neither thinks to ask if the breathing is adequately performed — a function which is of such vital importance, not only for the integrity of the pulmonary tissue itself, but for the well-being and health of the whole body. Upon the efficient performance of this act, we know, depends largely the condition of the circulation, assimilation and excretion, as well as the process of combustion, the greater or less completeness of which depending also upon the greater or less perfection of the respiratory act. And further, so far as the lung tissue itself is concerned, it responds very delicately to the manner in which it is used or disused. Full and free respiration of pure air strengthens the pulmonary tissue and nourishes it with well-oxygenated blood; its vitality is increased

<sup>1</sup> Read before the Boston Society for Medical Improvement, February 10, 1896.



in direct proportion to its work, exactly as is the case in muscular activity ; the resisting force of the lung tissue is also increased. On the contrary, inadequate and partial respiration, such as so many persons of sedentary habits and indoor occupations are accustomed to, throws into disuse more or less of the lung tissue and reduces to a minimum the respiratory function. In consequence of this the nutrition becomes defective and the tissue weakened, becoming an inviting soil to disease and the bacillus. The deprivation of the pulmonary exercise furnished by the articulation of words is said to be the cause of the frequency of pulmonary tuberculosis among deaf mutes, and I can readily believe it. Among the inmates of the Consumptives Home almost all, with the exception of teamsters, were of indoor occupations, which meant as a rule, insufficient respiration.

"There is no apparatus," says Lagrange,<sup>2</sup> "where we can verify in a more striking manner the law that 'action makes the organ' than in the respiratory ; no organ is so rapidly modified as the lung in accommodating itself to the more active working which is demanded of it." We all know that it is the apices of the lungs which offer the least resistance to the invasion of the tubercle bacillus, because they are the portions of the organ which remain habitually inactive in the inadequate breathing of sedentary life. Time and again have I heard the click or râle at the apices of the lungs on full inspiration in examining candidates for the gymnasium, which indicated that this portion of the organ was ordinarily inactive, and never have I detected it when the person has been in the habit of taking deep inspirations.

This question of proper respiration becomes one of

<sup>2</sup> Dr. Fernand Lagrange : *La Médication par l'Exercice*, Paris, 1894.



exceeding and especial importance to the person of sedentary habits and occupation, which is the condition perforce of a large proportion of our city population. The little round of the city dweller's life is one of limited movement and slight bodily activity. A short walk frequently comprises all the exercise he takes, and even this is often "more honored in the breach than in the observance." The modern elevator, even, is often a curse in disguise, for walking up stairs, which Sir Andrew Clark was so fond of prescribing for his patients, is, I believe, an excellent form of exercise as well for the respiration as the heart. Indeed, when one reflects upon it he will be struck with the similarity of the life and its results of the sedentary individual, who takes little or no exercise and eats and perhaps drinks too much, and the stall-fed ox or the *pâté de foie* goose; in both cases over-feeding and inactivity are the causes which lead to fat deposition and infiltration of the organs with a continual surplus of the products of incomplete combustion. Now the lungs suffer from this abnormal life quite as much as the liver and other organs; the lung tissue is only partially and inadequately brought into play, and, consequently, poorly nourished. The supplementary respiratory muscles are rarely or never called upon to do their important part in the act of respiration, and, in consequence, they atrophy and become incapable of action, like any other disused muscle of the body. As time goes on, the portion of the lungs which takes part in respiration becomes more and more reduced, and a large number of pulmonary vesicles become inactive. Whenever such a person is called upon to undergo any unusual exertion, like ascending several flights of stairs, climbing a mountain or riding a bicycle, he finds his breathing embarrassed, he suffers from a "thirst for air," for

the air cells in use cannot furnish the necessary oxygen. On the contrary, if he is in the habit of taking such exercise as calls into play the reserved pulmonary vesicles, then these cells are always ready to perform their function whenever any unusual exertion is demanded. And further, even in a state of repose these so-called reserved cells take part in respiration; one's "ordinary" lung capacity is larger, as I have frequently proved by the spirometer; the respiration is slower and fuller, and finally, this fuller respiration, introducing a larger amount of oxygen, produces a better hematosis and increases the general activity of the organic functions.

Now good breathing came naturally to man in his original state, for he was intended to be an active animal — to run and climb, to bend and twist his body, to stretch and extend his arms and, in brief, use all his muscles; and as long as he followed nature in this respect his lungs had full play and the respiratory muscles were maintained in a state of efficiency. So-called civilization, or at least city civilization, has so modified all this, that one's life has resolved itself into a mental hunt for subsistence rather than an active bodily one. The natural life with its bodily activity has become an artificial one of more or less bodily immobility, and what nature unconsciously did to promote and maintain proper respiration must now be done by conscious effort and artificial methods, like gymnastic and athletic exercises and training. True, a man could live in tolerable health in this inactive condition, only half filling his lungs, if he were always sure of remaining in it, but he never knows when an emergency may arise which will require the respiration which well-trained lungs can only give, be it an unwonted exertion, an acute disease, or exposure to a tubercle bacillus when the nutrition happens to be

poor or the system depressed. And further, the sense of physical well-being is much greater when the respiratory tide is full and strong, as the experience of all of us will testify after some exercise which makes large demands upon the "wind," as bicycling, for instance. As the late, lamented Baron Posse<sup>3</sup> has so well said, "To breathe well means to live well, to live longer and to live better."

Having then determined the necessity of full, free respiration, what are the means to obtain it? First, there are the indirect ones, in the form of general exercise, gymnastics, athletics, and all forms of muscular exertion, provided it is energetic enough. Of course, the result is obtained by a greater demand for oxygen and a greater production of carbonic acid, which requires more energetic respiratory activity. Now these are applicable not only to those in ordinary health but as well to those who suffer from some pulmonary lesion but at the same time are capable of a certain amount of muscular effort — bronchitics, the emphysematous in the intervals of the acute attacks, convalescents from pneumonia and pleurisy, and the tuberculous when not febrile.

The following case is an illustration of the beneficial effect of breathing exercises in pulmonary disease. Miss C., the head nurse of the Consumptives' Home, contracted while in service a pleuritic effusion of the right chest, presumably tubercular. The fluid filled two-thirds or more of the cavity. Aspiration was performed several times; and as soon as the patient could sit up, breathing exercises were instituted. The absorption of the remaining fluid and the expansion of the lung was prompt, and the process, I believe, was materially hastened by the persistent use of the respiratory exercises.

<sup>3</sup> Baron Nils Posse, G. M.: *Special Kinesiology of Educational Gymnastics*, 1894.

The general exercises which are good for increasing the respiratory power are very numerous, as we know. Walking, however, I do not consider a very valuable one. "A person who only works and walks," as a recent writer on bicycle exercise says, "hardly ever fills his lungs." There is swimming, tennis, rowing, bicycling, skating, golf, running, jumping, hand-ball, mountain climbing, going up stairs, the *cure de terrains* of Oertel, dancing, singing, reading aloud, free-hand classwork in the gymnasium, and rope-jumping. I was recently told by one conversant with the training of boxers that rope-jumping was a common form of exercise with them for increasing the "wind." All exercises which bring the legs into violent action are especially good for the respiration, on account of the number and size of the muscles employed. Secondly, there are the direct or local respiratory exercises, those especially devised for training and developing the respiratory muscles and lungs. Now these direct lung exercises are also applicable not only to the well but to those who, from pulmonary lesion or general bodily weakness, are unable to undergo the more active general exercises, for they increase the efficiency of respiration, without increasing the *need* of respiration, creating the "thirst for air." Of course, all exercise is interdicted to those suffering from acute inflammation, the febrile state or serious hemorrhage.

These especial pulmonary exercises are simple and yet efficacious: Standing erect in a well-ventilated room, or wherever there is pure air, with the hands on the hips and taking long deep inspirations and slow expirations, beginning at the bottom of the chest and filling up, so to speak. This, alone, done several times a day will often materially increase the lung capacity, as I have frequently verified. "Numerous observa-



tions," says Lagrange,<sup>4</sup> "prove that it is enough, voluntarily to take a certain number of deep breaths every day, to produce in a short time an increase in the circumference of the chest, which may amount to two or three centimetres."

In these breathing exercises the rhythm can be varied according to the following schedule :<sup>5</sup>

- (1) Slow and long inspiration and expiration.
- (2) Inspiration and expiration long and quick.
- (3) Slow and long inspiration, and long and quick expiration.
- (4) Long and quick inspiration, and slow and long expiration.
- (5) Short inspiration and long expiration.
- (6) Long inspiration and short expiration.
- (7) Short inspiration and expiration.
- (8) Inspiration by two or three stages or jerks, and expiration long.
- (9) Inspiration long and expiration by stages or jerks.
- (10) Inspiration and expiration by stages or jerks.

In all these exercises one should breathe through the nose only.

Then there are the various arm movements with their modifications, in connection with the deep breathing, slowly raising the arms to a horizontal position and then over the head until the hands meet, slowly and deeply inspiring while performing the movements, and expiring while lowering the arms, thus the supplementary respiratory muscles of the chest and shoulders are brought into action.

Raising the arms and then carrying them back and down, describing a movement of circumduction. Standing erect and straightening up and finally rising upon one's toes, deeply inspiring during this movement. Extending the arms in a horizontal position and carrying one of the legs back so as to offer a large base of support to the body. Lying on the back horizontally upon the floor or a table and raising the arms backward and over the head while inspiring ;

<sup>4</sup> La Médication par l'Exercice.

<sup>5</sup> De Bouffémont: Manual de Gymnastique Eclectique.

if lying upon a narrow table, the arms can describe a circle about the head. The exercises with wands or bar-bells, which demand rather more exertion perhaps than the free-hand movements. In the Swedish system of gymnastics there are almost an innumerable variety of respiratory exercises, most of which, however, are but modifications and combinations of a few simple movements, and most of them can be performed without apparatus. Then there are the gymnastic devices and apparatus for increasing the lung capacity and developing the respiratory muscles; the so-called "chest-developers" and "lung-expanders"; the "chest-weights" and "quarter-circle"; the high parallel bars and travelling rings; and the heaving movements of the Swedish gymnastics, which are usually exercises of hanging and climbing by means of rings, bars, ladders and poles.

Renzi<sup>6</sup> describes the following apparatus for prompting deep respiration, which he makes use of with beneficial results in his clinics as well as in his private practice. To two hooks in the wall are attached cords, and to these a cross-bar much like a flying trapeze; the height of the bar is adjusted to the height of the patient. This cross-bar is seized by the patient with outstretched arms, who leans forward, forming a curve with his body; the two points of support being the hands on the bar and the toes on the floor. In this position of the body the patient is forced to take deep inspirations whereby the thorax is much expanded. The standing position is then resumed, and the thoracic muscles relaxed, when a deep inspiration is practised. These two movements are performed alternately from twelve to twenty times a minute.

<sup>6</sup> Dr. E. De Renzi: *Pathogenese, Symptomatologie und Behandlung der Lungenschwindsucht*, 1894.

If the patient is too sick or too feeble to take any of these various exercises, either free-hand or with apparatus, he can be given passive respiratory exercise, much after the manner of the Sylvester method for producing artificial respiration. Sitting upon a bench or stool and leaning upon the chest of an attendant standing behind him, the arms are raised above the head synchronously with inspiration. With the lowering of the arms and pressure against the sides forced expiration is produced. This can also be practised in the recumbent position.

Although the movements of inspiration are the most important in the respiratory act, yet expiratory exercises have their place. These are generally passive, like the act itself. One which Lagrange especially notes is the following: The subject lies flat upon the abdomen on the floor or a bench and raises his head and shoulders, thus contracting the extensor muscles of the vertebral column. In this attitude the abdominal muscles are stretched and prevented from contracting and pulling down the chest walls. In this position forced expiration is practised. In emphysema especially, expiratory movements are useful; these can be simple direct pressure upon the chest walls, with various manipulations of the thoracic muscles, or a peculiar Swedish movement also noted by Lagrange; it has for its object the mobilization of the semi-ankylosed chest wall, which is a condition existing in chronic emphysema. The patient is seated astride a narrow bench or his legs are held and two attendants seizing him by the shoulders rotate the trunk upon its axis, alternately from right to left and left to right, the object being to mobilize the vertebro-costal articulations and to restore movement to the chest walls.

Besides all these methods of respiratory exercise

there are certain machines or apparatus devised by Zander and Nycander. Some excite deep inspiration by passive movements for raising the ribs, others render the expiration more complete by compressing the ribs through the use of girths or straps which compress the thoracic walls at the moment when the lungs empty themselves of air. The latter machines are said to render great service in pulmonary emphysema, where the expiration is always laborious and incomplete.

Finally, we have massage of the respiratory muscles, which the Swedish physicians always prescribe at the same time that active and passive gymnastic movements are given. As will be seen, the number of exercises available to produce better respiration are very numerous and varied, but the underlying principle is simple, namely, to bring into more vigorous play the muscles which expand the thorax, and at the same time excite deep, full, free breathing; to bring the vital force of the lungs to its maximum. It must be borne in mind that all exercises of the thoracic muscles for the purpose of producing an increase in that cavity must at the same time be coincident with deep breathing; the amplitude of the respiratory movements must be increased; the lungs must push out from within as well as the thoracic muscles pull from without. Once having established a proper respiration by the use of some of the simple respiratory exercises and devoting a few minutes to it every day the habit of full and deep breathing is formed even when one is in a state of repose. And further, one is fortifying himself against the possibility of disease of the lungs by thus maintaining the pulmonary tissue in an active, healthy and well nourished condition; and there is no portion of the apices which from insufficient use and poor nourishment is a menace to the individual by



offering a fitting soil to a wandering bacillus. In convalescence from pneumonia and pleurisy with effusion, the importance of expanding and revivifying, as soon as possible, the lung, whose functional capacity has been diminished and whose nutrition has been depressed, can hardly be overestimated. As Lagrange truly says: "In all the inflammatory maladies of the lungs there persists a tendency to stasis and passive congestion, to correct and obviate which no means is more efficacious than very ample and deep inspiration."

When the border line has been passed and incipient phthisis has been developed, respiratory exercises are a most important and precious means for restoring the weakened lung tissue and increasing its resisting power. The beneficial effects of the high altitude treatment are largely due to the fact that one is compelled to breathe fully and deeply in order to obtain the requisite amount of oxygen.

In every well-arranged plan of treatment of pulmonary tuberculosis, where any exercise at all is allowable, pulmonary gymnastics, carefully arranged and adapted to the strength and condition of the individual, should, I believe, be embraced. In the famous sanitariums abroad, where such excellent results are obtained, they play an important part in the treatment. We may in the future obtain a serum product which will accomplish all that was hoped for from tuberculin; but one must not forget that large numbers of consumptives are now being cured and restored to usefulness by means of the persistent application of nature's remedies, sunlight, abundant alimentation, continuous out-door life, hydrotherapy and good breathing. The *vis medicatrix naturæ* may not always give brilliant and rapid results, but when intelligently employed it is a method which rarely disap-

points either the confiding physician or trusting patient.

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